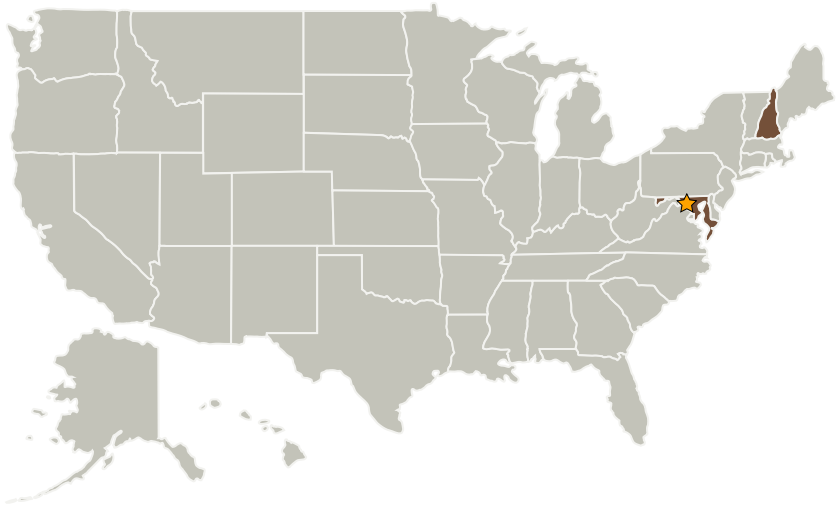
Lightweight Magnetic Cooler with a Reversible Circulator, Phase II

Completed Technology Project (2007 - 2009)

Project Introduction

NASA's future missions to investigate the structure and evolution of the universe require highly efficient, very low temperature coolers for low-noise detector systems. We propose to develop a highly efficient, lightweight space magnetic cooler that can continuously provide remote/distributed cooling at temperatures in the range of 2 K with a heat sink at about 15 K. The proposed magnetic cooler uses an innovative cryogenic circulator that enables a lightweight magnetic cooler to operate at a high cycle frequency to achieve a large cooling capacity. The ability to provide remote/distributed cooling not only allows flexible integration with a payload(s) and spacecraft, but also reduces the mass of the magnetic shields needed. The circulator has heritage in Creare's space-proven micro-turbomachinery technology which has demonstrated long-life (>10 years) with no-discernable emitted vibrations. The proposed system will be lighter than current multistage ADRs. In Phase I, we proved the feasibility of the magnetic cooler by showing its high thermal efficiency, light weight, and high reliability through detailed component design and system performance analysis. In Phase II, we will design, build, and test a prototype circulator module at design conditions. We will deliver the circulator module to NASA for integration into a prototype magnetic cooler.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Creare LLC	Supporting Organization	Industry	Hanover, New Hampshire

Primary U.S. Work Locations	
Maryland	New Hampshire

Project Transitions

December 2007: Project Start

December 2009: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors